**2012 High Priority Science Needs of the North Atlantic LCC**

**Science Need Summaries**

**1) Phase II of Designing Sustainable Landscapes**

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| Summary of science need: [*project continuation, not an individual science need*]Phase II of Designing Sustainable Landscapes |
| Key outcomes:Expand landscape change model from pilot areas to all Northeastern states; develop climate-habitat capability models for an additional 20 representative species; develop landscape design and decision-support portion of model; incorporate regional connectivity into ecological integrity assessment; incorporate sea level rise as suitable models are developed by other partners. |
| Justification:Building on work of the first phase, this project addresses high priority science needs to understand changes to future habitat capacity and ecological integrity due to climate change and other landscape changes, and needs to develop decision-support tools that consider these changes in formulating conservation strategies. |
| Partners/partnerships that benefit from addressing the need:Full range of partners and partnerships interested in conservation of terrestrial and aquatic resources informed by a regional landscape perspective. |
| Strategic plan component(s) and action(s) addressed:Ecological Planning: conduct regional climate change vulnerability assessments; develop and apply models that relate populations to habitat, ecological processes and other limiting factors; compile available information on threats and limiting factorsConservation Design: develop regional, consistent, spatial databases; assess existing habitat capacity; predict landscape change and future capacity; develop decision-support tools; develop landscape designs; test conservation design approaches |
| Anticipated cost / length of time:$406,000 for 1 year (partial funding of project; $469,000 proposed for second year) |
| Needed expertise:Existing team led by Kevin McGarigal of the University of Massachusetts |
| Other comments:Technical Committee discussion emphasized importance of extensive involvement of conservation managers to ensure usefulness of outputs in decisonmaking; the North Atlantic LCC must play a role in facilitating this process. Technical Committee members also encouraged efforts to make outputs readily available and underlying models transparent and, if possible, transferable or modifiable to reflect future needs. Proposal has been modified to address these issues and North Atlantic LCC staff and others are working with UMass to plan further interactions with decision makers. |

**2) Develop a regionally consistent aquatic habitat classification system, select representative aquatic/coastal species, and compile species-habitat relationship and range information for coastal, estuarine, and freshwater fish and other species**

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| Summary of science need: Address and synthesize foundational scientific information for coastal and aquatic habitats and species. This science need consists of three major components:1) Revise and update aquatic habitat classification system to provide a consistent definition of aquatic habitat in the North Atlantic.2) Complete the NALCC representative species process to identify aquatic (including coastal) species.3) Quantify and map current range distribution for aquatic (including coastal) species to assess species-habitat relationships, and identify priority areas and corridors for conservation.  |
| Key outcomes:1) Revised and defined aquatic habitat classification system, consistent throughout the North Atlantic LCC. This would build on the Northeast Aquatic Habitat Classification System (NEAHCS) by revising the current system and potentially incorporating additional components such as tidal and coastal influences, hydrological classification, or geomorphic or river confinement.2) Select a set of representative species for aquatic (including coastal) ecosystems that can serve as a focus for biological planning, conservation design, and conservation delivery within the North Atlantic LCC.3) Identify and map aquatic species distribution and habitat in the North Atlantic and use information to support decisions about priority areas for habitat protection and restoration. Also, identify existing data needs for species. Geographical scope includes North Atlantic and Mid-Atlantic subregions of Atlantic Coast Fish Habitat Partnership, which extends from Maine to northern North Carolina. Species include fish and potentially other high priority species such as freshwater mussels. Addressing the science need could include the following components: 1. Identifying data for collection: Review existing efforts, identify gaps, and identify data needed for collection.
2. Collection, synthesis and analysis of existing data: Information gathered could include data on threats, land use, species presence or absence, spatial data, and habitat distribution data. Compilation of these data could lead to identification of areas to protect/restore/enhance.
3. Database including spatial data useful to a variety of partners; spatial data could include habitat distribution layers, threats layers, habitat condition layers, and species distribution layers (potentially life stage based to allow linkages to varying habitat needs throughout the life cycle).
4. Decision support: Tool to assist in applying the database and spatial data in decision making.
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| Justification:1) A consistent aquatic classification system has already been identified as a high priority for Northeastern states and substantial work has been conducted to develop the system. The system can help serve as a foundation for selecting representative species and for defining species-habitat relationships more generally across a regional scale. It therefore serves as a basis for conservation design and delivery across the North Atlantic. Similar needs are being considered for funding by NEAFA and the Appalachian LCC, which have potential to complement this need.2) A fundamental step in Strategic Habitat Conservation is selecting species to serve as a focus for conservation design and action, and the North Atlantic LCC is piloting the use of "representative species" as one tool to achieve this goal. The rationale is to select species whose habitat needs or ecosystem function are similar to a group of other species so that the needs of all can be addressed, given that it is not possible to simultaneously assess all species individually. The process to identify representative species was initiated and completed for terrestrial species and was started for aquatic species, but has not been completed. Species to be included in the assessment of aquatic representative species would extend from headwater to coastal environments, and could include fish and aquatic macroinvertebrates. 3) This need has been identified as being a high priority for the Atlantic Coast Fish Habitat Partnership in its "Conservation Strategic Plan 2012-2016" and in its Science and Data Needs Assessment. By expanding definition of the need to include other species, additional aquatic resources and partners benefit. The information developed to meet this need is foundational for quantifying aquatic species-habitat relationships, quantifying threats for vulnerability assessments, and identifying priority areas for conservation (including habitat corridors). Mapping efforts could also tie into other mapping activities of landscape use, development, threats, or other relevant information. |
| Partners/partnerships that benefit from addressing the need:State fish and wildlife agencies, NEAFWA, and other state and regional environmental agencies including water planning agencies, NGO’s, municipalities, federal agencies, and New England Interstate Water Pollution Control Commission. Partnerships include Eastern Brook Trout Joint Venture (EBTJV), Atlantic Coastal Fish Habitat Fish Habitat Partnership (ACFHP), and Southern Aquatic Resources Partnership (SARP). |
| Strategic plan component(s) and action(s) addressed:Ecological Planning: Action 1, Develop and maintain lists of priority species and natural communities; Action 2, Identify representative species; Action 4, Compile and develop information on threats and limiting factors.Conservation Design: Action 2, Develop regional, consistent, spatial databases; Action 3, Assess the existing habitat capacity; Action 6, Develop decision-support tools. |
| Anticipated cost / length of time:1) Costs ($20,000) expected to be low because need relates to revision of an existing classification system. Science need is also subject of a proposal submitted to NEAFWA; LCC funds would be used to compliment and supplement this work, including integration of aquatic and coastal classification.2) $20,000/1 year (possibly contribution by U.S. Fish and Wildlife Service)3) $250,000-350,000/3 years |

**3) Consistent regional coastal mapping for habitat, species, infrastructure, and elevation in the North Atlantic (including Canada)**

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| Summary of science need:Inventory and compilation of existing coastal habitat, species and infrastructure mapping and elevation data for the North Atlantic LCC including Canada. |
| Key outcomes: 1) Compilation and synthesis of existing coastal habitat, species focus areas, infrastructure spatial data and elevations for the North Atlantic LCC coast (including Canada). Coastal habitat includes all intertidal habitats such as marshes, beaches, flats and rocky coastline as well as subtidal features including submerged aquatic vegetation beds. Species focus areas include any existing mapped focus areas in the coastal zone for fish and wildlife (e.g. migratory shorebird concentration areas). Infrastructure includes human-built structures that interact with coastal habitats such as seawalls, groins, jetties or other hardened shorelines. 2) Identification of gaps in information needed for regional assessments.3) Recommendations on best approaches to address these gaps and develop consistent spatial data. |
| Justification: There is an immediate need to provide regionally consistent spatial data and maps of coastal habitats and infrastructure to be able to effectively implement assessments and tools of landscape change and sea level rise in the coastal zone of the LCC. This coastal mapping would complement the regional terrestrial habitat classification and map and the marine CMECS classification and map. Although there are existing data layers such as NWI and various state coastal wetland mapping efforts, they are not always consistent and vary in how current they are. |
| Partners/partnerships that benefit from addressing the need: Multiple partnerships that are focused on the coast including Atlantic Coastal Fish Habitat Partnership, Atlantic Coast Joint Venture, Northeast Regional Ocean Council and Mid Atlantic Council on the Ocean. |
| Strategic plan component(s) and action(s) addressed: Conservation Design Strategy: Action 2, Develop regional, consistent, spatial databases |
| Anticipated cost / length of time: 6 months, GIS technician, plus oversight by coastal ecologist. Approximately $75,000. |
| Needed expertise: Knowledge of completed and ongoing coastal mapping and classification efforts, terrestrial habitat classification and mapping, and Costal and Marine Ecological Classification Systems; technical ability to compile and synthesize existing information |
| Other comments: May be able to utilize existing programs including U.S. Fish and Wildlife Service Coastal Programs and National Wetland Inventory. |

**4) Develop seamless land cover and stream mapping that spans the U.S.-Canada border of the North Atlantic LCC**

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| Summary of science need:Need for seamless terrestrial land cover (ecological systems, streams) that spans the U.S.-Canada border of the North Atlantic LCC. |
| Key outcomes:Complete ecological systems mapping into southern Quebec and Maritime provinces of Canada; coordinate stream mapping across state and provincial borders. |
| Justification:Foundational need for landscape conservation (building block for future science and tools) Anticipating the effects of climate change and better understanding regional connectivity would be substantially advanced by a consistent habitat map throughout the entire LCC. Lack of equivalent ecologically-based land cover datasets for U.S. and Canada is a major impediment to cooperative conservation planning and design. Most underlying datasets necessary to complete the work are available. |
| Partners/partnerships that benefit from addressing the need:Numerous conservation managers, and could add substantial Canadian involvement in LCC. Organizations and partnerships include Canadian Wildlife Service, state and provincial fish and wildlife agencies, Staying Connected, Two Countries One Forest, and the Nature Conservancy.  |
| Strategic plan component(s) and action(s) addressed:Conservation Design: Action 2, develop consistent regional spatial databases; Action 3, assess existing habitat capacity. |
| Anticipated cost / length of time:$150,000, 2 years (funding amount presumes need is also supported by Northeast Climate Science Center). |
| Needed expertise:Experience in land cover modeling; joint involvement of U.S. and Canadian partners. Original terrestrial habitat mapping work in Northeast states was conducted by the Nature Conservancy. |
| Other comments:Canadian interest in project is expected to be substantial. Involvement of Canadian partners in this project would be crucial. There are some unknowns regarding data availability, and availability of Canadian partners to participate. Also identified as high priority for Northeast Climate Science Center and could become a joint CSC-LCC project. |

**5) Restoration methods for climate adaptation given a range of state conditions with monitoring frameworks**

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| Summary of science need:Need to better understand salt marsh restoration techniques as a climate change adaptation strategy. |
| Key outcomes:Addressing the science need will result in recommendations or guidelines on how to modify techniques to restore natural processes to salt marshes in order to account for a range of climate change scenarios. It is anticipated that this will involve partnering with an existing restoration project that uses currently available management approaches (e.g. removing mosquito ditches or tidal restrictions). This project approach could either be proposed as a field demonstration site with monitoring protocol or as a numerical modeling component. Specific outcomes may include the following:a) A research framework for evaluation of salt marsh restoration techniques under different salt marsh state conditions; for a chosen technique an experimental protocol to vary the design options and evaluate the climate conditions appropriate to success. b) Recommended implementation criteria for a specific restoration technique. What are the best practices for project design within that technique, considering a range of state conditions (e.g. inundation period or frequency)?c) Quantitative evaluation of changes to ecosystem health as a result of each design and climate condition; if approach is a field demonstration site, this should be compatible with the Salt Marsh Integrity (SMI) score, to be used in overall SMI optimization modeling.  |
| Justification:Salt marshes provide important ecological services (e.g., fish nurseries, habitat for obligate salt marsh nesters) yet have undergone substantial alterations and degraded conditions may increase vulnerability to sea level rise. Although a variety of established and new salt marsh restoration techniques can be applied to increase salt marsh resilience as part of climate change adaptation, these restoration techniques have yet to be calibrated in a meaningful way to different starting points (e.g. different "marsh capital" levels, ditching densities, tidal ranges, salinities) commonly found in salt marshes along our coasts. Moreover, many land use managers do not possess a detailed understanding of how to sustain salt marshes over the long term given climate change. Determining the adjustments required to achieve greatest resilience given different starting positions on the spectrum of salt marsh conditions will greatly benefit practitioners and resource managers in increasing the quality and duration of our coastal salt marshes.  |
| Partners/partnerships that benefit from addressing the need:NGOs (e.g. land trusts), federal and state resource agencies, municipalities |
| Strategic plan component(s) and action(s) addressed:Conservation Design: Action 6, Develop and apply modelsConservation Adoption and Delivery: Actions 1 & 3, Provide products of biological planning and conservation design; Implement demonstration projectsMonitoring: Action 5, Develop metrics for measuring success of conservation actions |
| Anticipated cost / length of time:Two approaches will be considered, it could be proposed as either a:Field demonstration site ($180K/4 years); numerical model ($150K/2 years) |

**6) Better characterize the location or abundance of vernal pools across landscapes, and their use by amphibians**

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| Summary of science need:Need to better characterize the location or abundance of vernal pools across landscapes, and their use by amphibians. |
| Key outcomes:Review of methods and available data across the region for characterizing vernal pools; regional characterization of vernal pool presence or density, including relative value for amphibians |
| Justification:Foundational need for landscape conservation (building block for future science and tools); address needs of strategic plan and fits within conservation framework; applicable throughout region; important for understanding habitat capacity and threats to amphibians (some of which are representative species). Expected to complement current North Atlantic LCC project designed to identify priority amphibian and reptile conservation areas (PARCAs).State of science: vernal pools are not reliably mapped, have typically received little protection, and are susceptible to degradation and destruction. |
| Partners/partnerships that benefit from addressing the need:State and federal agencies, many organizations involved in land protection and amphibian conservation. |
| Strategic plan component(s) and action(s) addressed:Conservation Design: Action 2, develop consistent regional spatial databases; Action 3, assess existing habitat capacity. |
| Anticipated cost / length of time:$75,000 - $100,000 (initial phase, not complete vernal pool mapping of entire region) |
| Needed expertise:Experience in land cover mapping and modeling; involvement of state agencies and others with experience in vernal pools. |
| Other comments:Consistent, best management practices for vernal pools and vernal pool dependent species could be included in this science need. |

**7) Understand implications of marsh migration, fragmentation and conversion due to sea level rise on salt marsh dependent species**

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| Summary of science need : To better understand the management implications of habitat fragmentation and conversion due to sea level rise induced migration on salt marsh dependent bird species in the North Atlantic. |
| Key outcomes: Future prognosis of the ability of salt marsh habitat to support viable populations of salt marsh dependent species (i.e., 7 avian species including waterfowl and salt marsh sparrows).a) Understand the ramifications of sea level rise on resource management decisions for coastal habitat and dependent species today.b) Leverage the work of the SHARP Project (Saltmarsh Habitat and Avian Research Project) that is developing a detailed understanding of the habitat requirements, breeding ecology and demographics of salt marsh sparrows across the North Atlantic (Maine to Virginia). “The Conservation of Marsh Tidal Birds: Guiding Action at the Intersection of Our Changing Landscape”c) Develop a viable patch analysis approach for existing and future configurations of coastal salt marsh that can be applied across broader regions.d) Provide another key factor to the importance for coastal land acquisition at the local, state, and regional scale. |
| Justification: The project would benefit and advance previous investment in a high priority habitat type (salt marsh) and species (i.e., 7 salt marsh dependent avian species) in the North Atlantic. Substantial data are already available: methodology and model developed with key data layers for salt marsh migration zones (TNC/University of Connecticut – Coastal Resilience Program, www.coastalresilience.org) and detailed empirical data for species within initial study area (Connecticut and New York). However, this type of bridge between monitoring, evaluation and research with future management implications due to sea level rise have not been conducted in the larger region particularly for this habitat and these dependent species. This work would therefore address the immediate need for resource managers to use existing data and information to inform better decisions today to enable the viability of these species in the future. |
| Partners/partnerships that benefit from addressing the need:Federal, regional and state resource managers, academic institutions, NGOs, land trusts, municipalities. |
| Strategic plan component(s) and action(s) addressed:Conservation Design: Action 6, Develop decision-support toolsMonitoring: Action 5, Develop metrics for measuring success of conservation actions |
| Anticipated cost / length of time: Initial Pilot in CT/NY - $45,000/6 months |

**8) Identify comparable strategies for standardization of aquatic sample design, methodology, and monitoring for data analysis**

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| Summary of science need:Identify comparable strategies for standardization of sample design, methodology, and monitoring for data analysis |
| Key outcomes:a) Develop and coordinate standardized methods for monitoring data, including: parameters, collection methods, protocols, indicators, and frequency of monitoring. Monitoring considered would include water quality, temperature, and hydrological flow. b) Identify recent advances in science based approaches in sampling design and methods for monitoring and identify top needs for standardized data to focus future sampling effortsc) Assess compatibility of existing data sets, sampling design, methods, and monitoring schemesd) Identify priorities for data to be collected and maintained in a standardized format, based on consensus and agreement. |
| Justification:Information gathered contributes to defining baseline information that is necessary for the NALCC in designing landscapes. Resulting information could be used on a broad landscape scale (across state/local boundaries) to assess progress towards population objectives, detect changes in habitat quality, quantity, and distribution, and identify transitions in species and habitat composition. Also, coordination can be used to identify data gaps can serve as a clearinghouse and resource. Coordination will also include existing monitoring programs (federal, state, and other organizations), and can identify new monitoring or sampling needs. Link groundwater and surface water monitoring. |
| Partners/partnerships that benefit from addressing the need:State fish and wildlife agencies, NEAFWA, and other state and regional environmental agencies including water planning agencies, NGO’s, municipalities, federal agencies, and New England Interstate Water Pollution Control Commission. Partnerships include Eastern Brook Trout Joint Venture (EBTJV), and Atlantic Coastal Fish Habitat Fish Habitat Partnership (ACFHP). |
| Strategic plan component(s) and action(s) addressed:Ecological Planning: Action 4, Compile information on threats and limiting factors.Monitoring: Action 2, identify and support unmet priority monitoring needs. |
| Anticipated cost / length of time:$250,000/2 years |
| Needed expertise:Cross-agency representation with expertise in monitoring and data management. |

**9) Inventory and risk assessment for estuarine and marine invasive species from Maine to Virginia: identifying thresholds that influence distribution and expansion**

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| Summary of science need:Managersneed summaries of risk associated with estuarine and marine non-indigenous/invasive species (NIS). Key information needs include: which species are expected to expand/shift north (or to cooler ecosystems), which harmful NIS have eradication potential, where should NALCC partners look for the next harmful NIS? |
| Key outcomes:Inventory, risk analysis, and threshold identification for NIS. Elements include:a) A region-wide inventory of known estuarine and marine NIS based on results from rapid assessment surveys and on-going marine monitoring programs. For areas in the region where NIS have not been inventoried, regional networks will be used to conduct rapid assessments based on sharing methods with local partners.b) Categorize marine and estuarine NIS based on risk. Some examples of factors to assess risk include: dispersal method, habitat requirements, invasive in other regions, severity of ecological impact, potential for economic impact, and eradication potential. Existing threat classification systems for prioritization of marine NIS (e.g. Molnar et al. 2008) will be a foundation with additional factors added as needed. Literature should be reviewed for climatically matched regions where particularly harmful NIS occur (either native or invaded range).c) Compilation of thresholds determining NIS range/distribution (e.g. temperature regimes, salinity, and dissolved oxygen) that are associated with climate change and other anthropogenic influences. d) Compilation of existing rapid response plans (e.g. that evaluate various management options), and new plans to cover areas without response plans to address the most pressing threats or potentially damaging introductions. |
| Justification:Fills needs that address a major threat - changes in invasive species distribution. This information is needed by resource managers due to the potential large ecological and economic impact of NIS. |
| Partners/partnerships that benefit from addressing the need:Federal and state resource agencies |
| Strategic plan component(s) and action(s) addressed:Ecological Planning: Action 4, Compile information on threats and limiting factorsMonitoring: Action 2, Identify and support unmet priority monitoring needs |
| Anticipated cost / length of time:$225,000/ 2 years |
| Needed expertise:MIT SeaGrant, MA Bays program and CACO have led rapid assessment surveys throughout New England; Mid-Atlantic expertise is less well known.  |

**10) Understand and develop models to quantify and describe ecological flow in the North Atlantic**

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| Summary of science need:Understanding and developing models to quantify and describe ecological flow in the North Atlantic. Ecological flow refers to the quantity, quality, and timing of water flows necessary to sustain aquatic ecosystems and the associated resources that people depend on. |
| Key outcomes:a) Quantify hydrological and ecological impacts of multiple stressors (alterations of flows, barriers, urbanization, climate change, water pollution, etc.) on the landscape that can impact flow. Includes relating biological data with flow, which would be useful to build upon revised aquatic habitat classification efforts. Includes compiling air and water temperature data to develop predictive models, flow data, and hydrological and geological information. b) Define the natural flow of systems, including assessment of threats (including climate change) to understand impacts to future flow (including groundwater) conditions.c) Expand current efforts to wider areas (e.g., remainder of Connecticut River drainage, other areas).Product:d) Synthesize model results across states to compile information across the North Atlantic.  |
| Justification: Understanding ecological flow helps to define the thresholds of aquatic systems to maintain habitat. Identifying ecological thresholds is needed for integrated water resources management. Results can be used for applications such as restoration and adaptation strategies, and where and how to restore stream and riparian habitat now based on future flow predictions. Results can be used to set stream flow standards that can protect the entire hydrograph. Work can be connected with Appalachian LCC. |
| Partners/partnerships that benefit from addressing the need:State fish and wildlife agencies, NEAFWA, and other state and regional environmental agencies including water planning agencies, NGO’s, municipalities, federal agencies, and New England Interstate Water Pollution Control Commission. Partnerships include Eastern Brook Trout Joint Venture (EBTJV), and Atlantic Coastal Fish Habitat Fish Habitat Partnership (ACFHP). |
| Strategic plan component(s) and action(s) addressed:Ecological Planning: Action 4, Compile information on threats and limiting factors; Action 6, Develop and apply models. |
| Anticipated cost / length of time:$250,000-300,000 /3-4 years with incremental products |
| Needed expertise:Expertise in modeling water temperature and ecological flows. |
| Other comments:Also identified as high priority for Northeast Climate Science Center. |

**11) Improve characterization of forest structure and condition across the North Atlantic**

This science need was considered to be a high priority but was not sufficiently well defined to merit a full write-up and cost estimate. This topic will be an important one for the Technical Committee to discuss further with other partners and experts over the coming year. An example of what this need encompasses is better understanding of current and future distribution of early successional habitats given natural disturbance, human activities such as forest management, and inherent site conditions.